CONJECTURES AND CONTRIVANCES: ECONOMIC GROWTH AND THE STANDARD OF LIVING IN BRITAIN DURING THE INDUSTRIAL REVOLUTION [1]

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> *... in our opinion, it would be rash to attempt to draw a general price curve on the basis of such approximate figures, as it could only be done at the expense of scientific honesty; and a fortiori an attempt to make any mathematical comparison between the movements of prices and wages could only result in mystification.*
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> *Paul Mantoux (1928, p. 439)*

This paper is based on new estimates of nominal earnings, the cost of living and real earnings in Great Britain and Ireland over the period from 1770 to 1880. These estimates are intended as a contribution to two controversies.

The first is the long-running debate about the impact of the industrial revolution on the standard of living of the British working-class. It was confidently announced in 1983 that this issue had finally been settled in favour of a very optimistic interpretation, but I shall try to show that this verdict may have been premature. The second is the more recent - and still continuing - debate about whether or not the rate of growth of the British economy accelerated during the industrial revolution.

I will begin with a few words about each of these debates. In the subsequent sections of the paper I will look first at average nominal earnings, then at the cost of living index and the resulting trends in real earnings. Finally, I will consider the implications for the overall growth of the economy.

1. The standard of living debate

The debate about the effect of industrialization and capitalism on the standard of living of the mass of the people has been one of the longest-running and most vigorously contested in British economic history.[2] It is an issue which has been argued over since the early nineteenth century, and one which was of high interest and importance in its own right. In the 1950s it acquired added force and urgency when it was caught up in the far greater conflict between the contending ideologies of capitalism and socialism. If capitalism had led to a deterioration in living standards in Britain during the industrial revolution, then perhaps countries attempting to industrialize in the decades after World War II would be better advised to turn instead to socialism.

Many of the protagonists in the standard of living debate took positions related to these wider concerns, and impartial historical scholarship and passionate political convictions became perilously entangled. The emphasis on the relationship between past and present was most explicitly stated by Hayek:[3]

> Political opinion and views about historical events ever have been and always must be closely connected. Past experience is the foundation on which our beliefs about the desirability of different policies and institutions are mainly based, and our present political views inevitably affect and colour our interpretation of the past.

He further claimed that the public acquired their knowledge of the past from myths, and that there was:

> ... one supreme myth which more than any other has served to discredit the economic system to which we owe our present-day civilization ... It is the legend of the deterioration of the position of the working classes in consequence of the rise of 'capitalism' ...

It is not appropriate in this paper to rehearse all the aspects of this debate, but it may be useful to mention six key points which need to be kept clearly in mind in reflecting on this issue. It is only when we have specified precisely what the questions are that we can begin to determine the answers.

(i) What is the time period and, in particular, when does it end?

The later the date the more optimistic the conclusion: as the economy expanded the benefits were gradually diffused more widely. Fruitless conflict arising simply from the choice of different end-points should thus be avoided. I shall cover the years from 1770 through to the late nineteenth century and try to establish what happened to real earnings at successive stages during the course of this period.

(ii) Are we interested in long-term trends or in short-period cyclical fluctuations?

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[2] See Taylor (1975) for an excellent introduction to the initial stages of the debate and reprints of the major contributions by E. J. Hobsbawm, R. M. Hartwell and others. The current state of the controversy is reviewed by Engerman (1995), with perceptive reflections on the many empirical and conceptual issues it has raised. Flinn (1974) surveys most of the previous quantitative estimates of wages and prices.

[3] Hayek (1954) pp. 3 and 9-10.

The British economy experienced occasional severe depressions, for example, in the early 1840s. This was part of a succession of short-term business cycles, and it would be possible to argue that the phenomenon of alternating periods of boom and bust is one element in the case against capitalism. An alternative and, in my view, preferable approach, is that these cycles are best treated as a separate issue which should be kept separate from an appraisal of the long-term trend in the standard of living. It is then, of course, essential to make comparisons between years at similar points in the trade cycle.

(iii) Is our concern specifically with the effects of early industrialization, or more broadly with the experience of the working class, regardless of what determined that?

This is a vital point because the period 1770-1830 covers not only the early stages of industrialization, but also the two decades of the Napoleonic Wars, a record level of harvest failures associated with abnormal weather conditions between 1790 and 1815, and an unprecedented acceleration of population growth.[4] It is difficult to distinguish accurately between the effects of these four inter-related features of the period, and my main concern will be with the overall outcome, but the presence of these different factors must be recognized in any analysis of the determinants of the trends in nominal wages and prices.

(iv) How do we define the working class and how do we deal with differences within this class, for example between occupations or regions?

The present paper covers manual (blue-collar) wage-earners and excludes salaried (white-collar) workers. The distinction is inevitably slightly blurred at the margin (for example the treatment of shop assistants as manual workers is somewhat arbitrary) but in general the dividing line is clear. Many writers on this topic have emphasized the diversity of experience within the manual working class, by occupation, region, skill and gender. Any attempt at quantitative assessment has certainly to embrace and record the divergent outcomes represented, for example, by the advance in the position of skilled artisans operating new machines and the deterioration in the conditions of displaced handicraft workers. It is also necessary to take full account of the varied experience of successive cohorts of workers. But ultimately a national aggregate measure, derived from a wide array of component indices, is *also* required if any broad conclusions about the overall outcome for the working class are to be drawn. For this purpose a weighted average of the sort constructed in the present paper is the most appropriate procedure. This effectively treats the movements in the wages of each individual worker as of equal importance.

(v) What do we mean by the standard of living?

This is perhaps the most difficult and controversial aspect. The present paper deals only with a narrow interpretation of the standard of living relating to real wages and the potential private consumption of material goods and services. It thus ignores important but less tangible factors, covered by phrases such as 'the quality of life'; for example, the impact of factory discipline and time-keeping, the intensity of the working day, the consequences of factory employment for family life and for female and child labour outside the home, the effects of urban overcrowding and pollution. Public services, notably for health and sanitation, are also omitted from the reckoning. Trends in real wages thus measure only one aspect of living standards, but it is a fundamental and wide-ranging aspect.

(vi) Finally, it is necessary to specify whether the charge to be investigated is that the living standards of the masses actually deteriorated, or only that the workers did not share in the rise in national income brought about by industrialization and modernization.

It is not always clear in the heat of debate whether the pessimists were making the stronger or the weaker claim. I shall try to see which, if any, version is supported by the new evidence.

2. The rate of growth debate

Here the starting point, as for so much other work on the industrial revolution, is the outstanding study by Phyllis Deane and Max Cole (1962). Their estimates of British economic growth over this period were derived by two distinct procedures, reflecting a division of labour between the authors. For the eighteenth century, indices of aggregate real national product were compiled from the output side, using a variety of quantity indicators for each of the main sectors of the economy. For the nineteenth century, estimates were made of the different categories of nominal income, and these were deflated to obtain series for the real national product. The two series were then spliced in 1800.

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[4] Between 1770 and 1830 the population of England doubled from 6.5m to more than 13m; Wrigley and Schofield (1981) p. 529. The relative impact of the wars and of other factors is discussed in Williamson (1984), Crafts (1987), Williamson (1987), and Mokyr (1987).

These pioneering estimates were quickly challenged by a number of writers, of whom the most persistent and effective was Nick Crafts. He published a succession of critical articles probing various weaknesses in the Deane and Cole indices for both the eighteenth and the nineteenth centuries. On the income side, he demonstrated that they had chosen an inappropriate price index for the deflation of the nominal series, and that this had seriously distorted their findings for the early part of the nineteenth century (Crafts, 1980). On the output side he pointed to weaknesses in their procedure for estimating both agricultural and industrial output (Crafts, 1976, 1983). His contribution culminated in an alternative set of estimates of real GDP based on revised indices for agriculture, industry and services. These covered the whole period from 1700 to 1830 on a consistent output-side basis (Crafts, 1985a).

The result of these new estimates by Crafts was a substantial downward revision of the rate of growth of total and per capita real GDP. Independent work by Knick Harley (1982) criticising an earlier index of industrial production constructed by Hoffmann (1955) yielded a similar conclusion. The Deane and Cole estimates had essentially confirmed traditional views of a sharp acceleration in the growth of the economy in the closing decades of the eighteenth century, an interpretation easily consistent with the notion of an economy transformed by an industrial revolution, or - to use Rostow's modern metaphor - of a take-off. By contrast Crafts and Harley argued that there was no dramatic change, only a gradual rise to a relatively modest rate of growth.

Table 1. Growth of the British Economy, 1700-1831 (Annual percentage growth rate)

A. Real GDP per head

	1700-1760	1760-1780	1781-1801	1801-1831
Deane and Cole	0.45	-0.04	1.08	1.61
Crafts	0.31	-0.05	0.41	0.45

B. Industrial production

	1700-1760	1760-7170	1770-1801	1801-1831
Deane and Cole	0.97	1.06	2.22	3.44
Hoffmann	0.75	1.48	2.66	2.74
Crafts and Harley	0.75	1.12	1.27	2.72
Cuenca Esteban	0.74	1.36	2.61	3.18

Source: Crafts and Harley (1992, 715); Crafts (1985, 45), Cuenca Esteban (1994, 88).

This revisionist attack on a cherished institution has inevitably provoked fierce and prolonged controversy which is still raging in the pages of the *Economic History Review*. Some critics suggested that the whole attempt at quantification was misguided and that no worthwhile measurement was possible for this early period. Attempts to advance by successive revision were presented as proof of the inherent unreliability of the estimates offered, and the whole quantitative enterprise was thus discredited in a way which would never be applied to corresponding debates and revisions conducted with literary evidence. Others accepted the value and legitimacy of the attempts to measure economic change over the period of the industrial revolution, but were bitterly critical of specific estimates and methods.[5]

In the latter camp Cuenca Esteban has been an especially polemical participant, arguing for the possibility that 'British economic growth was faster and more sustained than revisionist writers would have us believe' (Cuenca Esteban, 1994, 66-7). The growth rates implied by his proposed revisions to the index of industrial production are compared with these other estimates in the lower panel of Table 1. Although he does not claim that his own estimates have any definitive status, he believes that they do: 'serve to reinforce ample qualitative evidence pointing to a major discontinuity in British social and economic development during the last three decades of the eighteenth century.' (Cuenca Esteban, 1994, 68). Accordingly, he suggests, 'the dwindling growth rates' obtained 'through ten years of guesswork' by Crafts and Harley should be discarded in favour of much higher estimates, consistent with those derived by Hoffmann and by Deane and Cole.

Throughout this dispute income-based estimates have largely been neglected, and the recent discussion of economic change has focused almost exclusively on the output-based series. However, the incomplete and fragile nature of the available data creates a strong case for the construction, on a consistent basis, of independent estimates of national product from the income side. The present paper on real wages is intended as one step in a larger project designed to do this for the whole period from 1770 to the late nineteenth century. If the work can be carried through to a satisfactory completion it will provide a valuable check on the output data, and will also add to our understanding of changes in the structure of incomes during the initial phase of industrialization. The research is still incomplete, but I hope these preliminary results will be of some interest.

[5] Notable contributions include Hoppit (1990), Jackson (1992), Berg and Hudson (1992, 1994), Crafts and Harley (1992, 1995), Cuenca Esteban (1994, 1995).

3. New estimates of nominal full-employment earnings

Any attempt to construct a new index of average nominal earnings during and after the industrial revolution has to confront numerous difficult problems in the context of a period when the necessary data were seldom collected and even more rarely preserved. Some of the major issues include the changes in the structure of agriculture and in the work of male and female farm labourers and servants; the rise of new manufacturing industries and occupations, and the decline of others, a process illustrated most vividly by the fate of the hand-loom weavers; the impact of successive technological changes such as the spinning jenny, the water-frame, and the mule; the changing role of women and children as the domestic system slowly gave way to workshops and factories; and the shifts in the location of activity, exemplified by the decline of the woollen and worsted textile industry in Norwich and the South-West, and the rise of thrusting new centres in the West Riding of Yorkshire.

This is not the place to describe the details of the inadequate sources and highly debatable conjectures that lie behind the present estimates, but a brief account of the main sources is given in Appendix A. Some of the series rely for all or most of the period on well-known indices compiled by previous writers, notably A. L. Bowley and G. H. Wood, and these rest on relatively secure foundations. Over a period of some two decades these two distinguished scholars energetically extracted and exploited all the then available sources of information on wage rates and earnings, and their main estimates are based on a vast quantity of material, carefully analysed and expertly synthesized. In 1906, when Bowley reviewed the work that he and Wood had done since his first paper in 1895, he thought that it would in the end be possible to have:[6]

> trustworthy accounts of the course of wages in the nineteenth century in industries which include about half our occupied population. We are not likely to be able to construct index-numbers for boot-makers, tailors, unskilled labourers not attached to the industries named, dock labourers, domestic servants, railway men and many others.

Little has changed in this respect since this was written, and it remains the case that it is only possible to cover these additional workers, or to extend the series further back into the past, if we are willing to tolerate lower standards of evidence and of reliability than Bowley and Wood thought acceptable. The case for quantification in the face of the multitude of gaps and uncertainties in the available data is not that it provides definitive estimates (however sharp and secure the results might look when finally set out in neat arrays of printed tables). It is, rather, that it helps to establish orders of magnitude, and to test how robust or vulnerable the estimates are to the different assumptions and judgements the statistician is forced to make in the face of a lack of satisfactory evidence.

However, it is only by attempting to cover these sectors that we can form any judgement of how much difference their inclusion is likely to make to an overall index. It seems especially desirable that this question should be examined, given that conditions in the markets in which these workers offered their labour differed very greatly from those in the major industries. In particular, many of the wage-earners omitted by Bowley and Wood were largely unaffected by any form of technological change. Furthermore, it was usually in these same sectors that there was an excess supply of labour. Trade unions were either non-existent or extremely weak, and the workers' ability to organize in support of claims for higher earnings was correspondingly limited.

As a first step separate estimates of the male and female occupied population were constructed for Great Britain at decennial intervals from 1771 to 1881. Each of these was classified by sector or occupation, and these estimates for each sector were then further sub-divided to distinguish three categories of income-earners: employers and the self-employed, salaried workers, and wage-earners. A brief description of the sources and procedures is given in Appendix B. Annual estimates of the number of wage-earners in each sector were obtained by interpolation between these benchmarks and provide the weights for the component wage series.

Annual estimates of the movements in earnings were then assembled; so far these cover 24 separate occupations or industries, accounting for some 80 per cent of the total number of wage-earners in Great Britain in 1851. There are still a number of other sectors for which indices can be compiled, and these additional series will make it possible to deal more adequately with some of the problems of transition noted above, but it is unlikely that they will change the overall picture to any significant degree. The main workers omitted or inadequately covered in this preliminary version are shop assistants; milliners and dress-makers; male and female farm servants in England and Wales; and all wage-earners employed in the manufacture of iron and steel, of metal-using items such as tools, guns, cutlery, chains, needles and nails, of lace, silk, linen and jute textiles, and of food, drink, glass, and timber products.

A few important aspects of the definition of the present indices should be noted. The series are intended to measure weekly *earnings* (not wage-rates), assuming *full-employment*. In principle, they should thus capture relevant changes in the composition of the labour force by age, gender, skill or region, and should allow for the

[6] Bowley and Wood (1906) p. 148; the named industries to which he referred included agriculture, engineering, and building.

effect on earnings of overtime payments and of piece rates or other systems of payment by results. The series include an addition for the value of board and lodging where it is a substantial element of the total remuneration, but minor perquisites and allowances are not included.

A few of the indices for manufacturing and building cover the whole of the United Kingdom, but the Irish wages in these sectors are too small to have any appreciable effect and the primary indices can be treated as relating essentially to Great Britain.

The absolute value of earnings in each industry was generally taken from the estimates of average annual earnings in 1881 obtained in an earlier study (Feinstein, 1990). These in turn were derived by working back from estimates based on the official *Enquiry into Earnings and Hours in 1906* (PP 1909 LXXX) checked wherever possible against the information collected in the first Board of Trade investigation, *Rates of Wages in 1886* (PP 1893-94 LXXXIII, Pt II). A crucial implicit assumption is thus that all dimensions of the composition of the wage-earners in 1881 are accurately reflected in the level of average earnings at that date, and that the effects of any changes in skill, gender, age or other dimensions as we move back to 1771 are fully incorporated in the earnings indices. This is undoubtedly a rather heroic assumption, given the sweeping changes which occurred during this period. However, it seemed best to proceed in this way so that it would be possible both to specify clearly the basis on which the indices were constructed, and to test the resulting level of average earnings at various dates against independent benchmarks for those years.

For the aggregate index each separate index of earnings is weighted each year by the corresponding wage-bill, i.e. for each sector or occupation the numbers employed multiplied by the average wage in each year. The movements in the index thus measure both the changes in full-employment nominal wages within each sector and the effect of movements between sectors.

The initial estimates to be presented are defined on the basis outlined above. Two further series are given in section 6. The first attempts to correct the estimates for Great Britain to allow for unemployment and short-time working; the second extends the estimates to cover the United Kingdom by the inclusion of the earnings of Irish agricultural labourers.

It may be helpful to give just one illustration of the sort of rough estimation that is required for many of the additional series which previous scholars have wisely refrained from covering. Wood compiled a superb index of earnings in the cotton industry but it only starts in 1806. In an attempt to obtain at least a coarse picture of a rapidly changing and poorly recorded scene before that date two new indices were constructed, for spinning and for weaving, and combined in a weighted average. The spinning series, shown in Table 2, is itself a very crudely weighed average of estimates of the weekly earnings of women, men and children engaged in five different types of spinning undertaken at home or in the newly-built mills. The estimates are given for eight dates from 1770 to 1806, designed to take account of the changes in earnings and in the composition of the labour force arising from the technological innovations and associated economic changes in spinning, as these are described in the literature on the early cotton industry.

Table 2. Earnings of Men, Women and Children in Cotton Spinning, Selected dates, 1770-1806 (shillings per week, with rough percentage weights in brackets)

	(1) Hand spindle (Women)	(2) Jenny (Women and children)	(3) Throstle Spinners	(4) Mule Spinners	(5) Mule Piecers	(6) All
1770	6 (70)	8 (30)				6.60
1775	4 (60)	6 (40)				4.80
1780	3 (50)	9 (50)				6.00
1790	3 (20)	9 (45)	4 (20)	10 (15)		6.95
1795	2/6(10)	9 (40)	4 (30)	22 (7)	4 (13)	7.04
1797	2/6 (5)	8 (15)	4/6 (20)	10 (50)		7.23
1804	-	-	7/3 (20)	11/6 (80)		10.65
1806	-	-	9/1 (15)	24(28)	5/9(57)	11.37

Sources: Bowley (1900) p. 119; Collier (1964) pp. 17, 32, 41 and 91; Hammond (1919) p.56; Mantoux (1928), p. 433-6; Pinchbeck (1930), pp. 139-51 and 191; Unwin (1924) pp. 130-3, 168, 191 and 195-203; Wadsworth and Mann (1931) pp. 401-5.

We come now to the initial results. The provisional indices of nominal earnings are summarized in Table 3 in the form of five-year averages with 1770-72 as 100, but as already noted these are not the base years. Indices are given for six sectors - agriculture, building (including railway construction), mining and manufacturing, transport, domestic services, and the armed forces - and for the economy as a whole. For the overall average the equivalent in shillings per week is also shown in the final column.[7]

Table 3. Average Full-time Money Earnings, Great Britain, 1770-1882
(Five-year averages, 1770-72 = 100)

	(1) Agri-culture	(2) Build-ing	(3) Mining & Manu-facturing	(4) Trans-port & storage	(5) Domestic service	(6) Armed forces	(7) All sectors 1770-72 = 100	(8) All sectors Shillings per week
1770-72	100	100	100	100	100	100	100	7.1
1773-77	101	105	103	108	101	101	103	7.4
1778-82	103	110	111	138	104	105	109	7.8
1783-87	104	112	118	114	105	99	109	7.8
1788-92	110	118	130	123	110	103	117	8.4
1793-97	137	133	145	172	125	130	140	10.0
1798-02	167	149	165	197	150	152	166	11.8
1803-07	200	178	186	215	158	145	187	13.3
1808-12	214	205	191	255	188	158	204	14.6
1813-17	206	209	195	233	185	149	200	14.3
1818-22	184	209	174	204	166	142	180	12.9
1823-27	154	208	175	209	163	140	171	12.2
1828-32	157	197	170	204	162	139	169	12.1
1833-37	159	197	176	205	156	139	171	12.2
1838-42	170	210	183	211	168	146	181	12.9
1843-47	164	220	190	212	172	145	185	13.2
1848-52	158	217	191	215	170	141	183	13.1
1853-57	186	230	212	247	198	161	208	14.9
1858-62	189	245	218	235	199	163	213	15.2
1863-67	197	260	234	243	214	168	228	16.3
1868-72	213	277	245	251	230	180	242	17.3
1873-77	244	310	275	271	248	195	271	19.4
1879-82	240	313	257	262	253	201	265	18.9

On these estimates we find that average earnings rose slowly from about 7/- at the beginning of the 1770s to about 8/6 in the early 1790s, and then climbed more rapidly during the war-time inflation to peak at about 14/6 at the close of the Napoleonic Wars. They then dropped back to approximately 12/- in the early 1830s before rising very gently to almost 12/6 per week in mid-century, still below the war-time peak in money terms. Subsequent growth was more rapid, and earnings reached a new peak of almost 19/6 per week in the mid-1870s. There was thus an overall rise in nominal incomes of approximately 170 per cent over a hundred years.

Underlying the levels and trends in average earnings there is a marked diversity in the experience of the individual sectors and occupations on which Table 3 is based. In comparing the movements in these constituent series the differences in their nature and scope needs to be borne in mind. Some (including mining, building, engineering, transport, and the armed forces) relate to exclusively or predominantly male wage-earners. Others, such as agriculture, cotton and woollen textiles, and domestic service cover the earnings of men, women, and juveniles, and thus may be affected also by changes in the composition of the labour force.

A synoptic view of the movements in these series can be obtained by considering the changes over three periods each measured between points which are roughly comparable in terms of the underlying cyclical fluctuations. The first of these periods runs from 1770-72 to 1808-12, during which average money earnings increased to approximately double the level at the starting point in the early 1770s. This was also true of the great majority of the individual series. The combination of harvest failures, the diversion of resources to the war against France, the related distortions to the normal flows of international trade and other factors caused an exceptionally steep rise in prices, and this in turn put considerable pressure on employers to prevent widespread

[7] For those not familiar with nineteenth century currency one shilling equals 5p.

destitution by raising wages roughly in step with prices. The inflationary process thus appears to have been a powerful unifying factor in determining the movements in earnings in different sectors.

There were, however, a few exceptions to this general pattern. Merchant seamen were able to obtain their usual war-time premium and their earnings increased appreciably more than the average. In the woollen and worsted industries there was an exceptionally rapid increase in earnings as a result of the transition from women spinning at home on the wheel to men spinning in factories on the jenny and the mule. At the other end of the range, domestic servants and the armed forces fell behind other sectors because the employers provided board and lodging and there was less pressure to increase the cash element of total remuneration;[8] and the footwear and printing trades also lost ground.

The pattern of individual changes in the second period, from the end of the Napoleonic Wars to the mid-1850s was very different. Average money earnings declined until the early 1830s and then recovered, ending at roughly the same nominal level in 1853-57 as in 1808-12. However, this was the outcome of contrasting movements in two broad groups of industries. In agriculture, cotton and wool textiles, and the merchant service, the initial decline in nominal earnings was much more severe than in other sectors, and the level at the end of the period was still well below the previous peak. When the war ended the wages of agricultural labourers were depressed by the combination of improvements in harvest technology, an excess supply of labour, and the collapse of farm prices.[9] In the textile industries the mechanization of weaving and the displacement of male by female labour drove down overall earnings; and the relative earnings of seamen reverted to their customary peace-time levels.

In most other sectors, however, the dominant trend over this period was stability, followed by a gently increase in the upswing of the mid-1850s. Well-organized craftsmen in industries like building, engineering and shipbuilding, and printing, were able to restrict entry into their trades and so prevent any reduction in their nominal earnings, while the force of custom (promoted both by the craftsmen and by their labourers) served to preserve the relative position of the unskilled workers in these industries, despite the potential competition from the surplus of labour in the rural areas. Elsewhere, increasing demand for their services was sufficient to maintain the nominal earnings of domestic servants, soldiers and sailors, and of the miners who were also able to make significant gains in the boom at the end of this period.

The final period covers the twenty years from the mid-1850s to the mid-1870s. During this period there was once again a reasonably uniform pattern. The increase in average money earnings of about 30 per cent was shared by many of the major sectors, including agriculture, building, mining, and domestic service. Only cotton and woollen textiles advanced significantly more than this; and only the tailors and the seamen, railway workers and others in transport and storage lagged well behind.

It is also possible to decompose these estimates to distinguish the contribution to the overall growth of movements in earnings within each of the separate sectors (industries or occupations) and movements between sectors. When this is done it emerges that almost all of the improvement resulted from changes within the sectors, not withstanding the large changes in the composition of the labour force, notably the decline in the share of agriculture.[10]

Comparison with other estimates

It is appropriate at this point to enquire how these results compare with previous estimates.

The first series which should be considered was compiled almost a hundred years ago by Wood (1899) for selected years from 1790 to 1860. His index is an unweighted average of series for 22 towns and two coal fields, covering urban workers in a variety of industries and occupations. It is thus more limited in scope than the present index, but the latter can be adjusted to a comparable coverage by taking only the series for building, mining, manufacturing and transport in columns 2, 3 and 4 of Table 3.[11] Wood's series initially rises some 7 per cent above the present estimate at the war-time peak, but in the 1830s the present estimate shows a recovery not reflected in Wood's data. The indices then move in harmony through the 1840s and 1850s, with the present series remaining roughly 10 per cent higher. The net result is that the present index shows money earnings improving by almost 20 per cent between 1816 and 1860, while Wood's index indicates no change.

[8] This would probably apply also to farm servants: the high cost of providing board was one of the major reasons for the decline in service in husbandry; Kussmaul (1981) pp. 120-22; Snell (1985) pp. 67-103.

[9] See, for example, Jones (1964) and Collins (1969).

[10] The contribution of intra-sectoral movements accounts for as much as 90 per cent of the overall increase between 1770-72 and 1848-52 when average earnings are calculated as a Laspeyres index using either initial or end-period weights rather than current-year weights.

[11] Wood noted that each year in his index should be considered as the average of a three-year period, and corresponding averages have been taken for comparison.

More recently, Williamson (1982) has constructed an index of nominal wages for nine selected years between 1781 and 1851, and for every tenth year thereafter. His series was compiled for a special purpose and differs from the present index in definition and scope. In particular, it covers only adult males; makes no allowance for changes in the composition of the labour force within individual industries; and omits some sectors of particular importance in the transition to the factory economy, for instance the woollen and worsted industries. Nevertheless, both indices incorporate the major Bowley and Wood series (including those for agriculture, building and engineering), and the weight of these common sectors is sufficient to ensure that the general trends indicated by the two indices are broadly similar.

There are, however, small differences which lead to some significant divergence in the pattern of movement over the period as the direction of the difference changes. For example, in the late eighteenth century the present series rises by 34 per cent compared to Williamson's 25 per cent. It then traces a modest gain of only 13 per cent between 1797 and 1827, whereas his records a rise of 32 per cent. From then on the new estimates present a marginally more optimistic picture, with an overall improvement between 1827 and 1881 of 57 per cent, rather than 41 per cent.

The recent estimates of family income collected by Horrell and Humphries (1992) come closer in scope to the present series, and provide a valuable alternative source of evidence regarding the trends in average earnings. Their objective was to measure actual family incomes as measured by a selection of household budgets. These include the earnings of women and children, and in general also include transfer payments in the form of poor relief and grants from charities, and allow for the loss of earnings in periods of depression and unemployment. However, the sample is relatively small, so that the results for non-farm occupations may not be fully representative; and the reliability of many of the budgets must also be rather uncertain. It is thus not surprising that the movements in these estimates of family income do not correspond closely with the present series.

The Horrell and Humphries series indicates much less improvement from the early 1790s to the peak in 1816-20, but then rises from there to the late 1830s when the present estimates are falling. The family incomes then show a sharp drop in the early 1840s and a recovery in the latter part of the decade, neither of which are reflected in the present series. Finally, they show almost no improvement in the 1850s and early 1860s while the present estimates rise by almost one-fifth.[12]

To conclude these comparisons we can check the estimates against the figures for average earnings given by contemporary statisticians such as Massie, Colquhoun, and Baxter. In compiling the present series I deliberately refrained from using their information on earnings, so that it is appropriate to make such a comparison. There are minor qualifications which might be made at various points, and the reliability and interpretation of some of the contemporary estimates can be questioned.[13] Nevertheless, the general closeness of the agreement in Table 4 is very encouraging, and these independent benchmarks suggest that the present index has successfully tracked the main changes in average incomes over the long period from 1881 back to the 1770s.[14]

Table 4. Comparison with Contemporary Estimates
Average Annual Earnings, Great Britain, all sectors, 1760-1884 (£ per annum)

(1) Date	(2) Source	(3) Contemporary estimate	(4) Present estimate
1884	Levi	46	48
1867	Baxter	40	43
1866	Levi	40	42
1846	Smee	22	34
1803	Colquhoun	28	31

[12] The substantial disagreement in the 1840s is not significantly reduced when the present estimates are corrected to allow for cyclical unemployment in industry and seasonal unemployment in agriculture (see section 6 below).

[13] See Deane (1956, 1957) and Lindert and Williamson (1982, 395-8). In particular, the latter treat the estimates given by Massie (1760) as family earnings, and consider that as such they are too either too low or else assume a very short work week. It is perfectly true that the logic of the exercise Massie was undertaking in relation to the consumption of sugar required estimates for all breadwinners in the family. Nevertheless, it seems clear from his other writings that his 1760 estimates refer only to the adult male wage-earners. Elsewhere, for example (Massie, 1758, 104), he explicitly raised the husband's earnings of 7/6 per week by 4/6 to cover income earned by a wife and two children.

[14] The one exception is Smee's figure for 1846, but this stands out as low in comparison with those by his predecessors and successors.

1802	Bell	30-40	30
1800	Beeke	30	30
1760	Massie	17	18 [1]

[1] The present estimate is for 1770.

Sources:

Levi (1885), pp. 4-6.

Baxter (1868), pp. 51 and 56, adjusted to a full-time basis.

Smee (1846), pp. 4-8.

Colquhoun (1806), p. 23 for England and Wales; the estimate is given as an average wage per family of £42 and I have assumed - following Beeke, pp. 121-3 - that there were 1.5 wage-earners per family.

Bell (1802), p. 137; Bell says that annual average earnings were probably £40, but used £30 for his calculation.

Beeke (1800), pp. 121-3.

Massie (1760); see also Mathias (1957), p. 43.

Overall, therefore, it appears that the new series have helped to refine and extend the basic picture established by earlier scholars. They should be more accurate, and also provide more comprehensive and complete series which will permit closer analysis of the interesting diversity in movements within and between sectors.

4. A new cost of living index

We turn next to the cost of living index and movements in real wages. Here there are significant differences between the present series and earlier estimates. The deflation of money earnings is based on a revised version of a recently published cost of living index (Feinstein, 1995). This covers eleven types of food, together with beer, coal, candles, clothing, footwear, and rent. It is constructed by chaining three Laspeyres indices for overlapping sub-periods: 1780-1820, 1811-50 and 1841-70, with 1780-84, 1820-24 and 1850-54 as the respective base years.

For many of these items the new index relies heavily on institutional and wholesale prices. These were severely criticised on various grounds by Ashton (1949), and almost all later writers have repeated his strictures. The alleged deficiencies are said to include possible divergence in the movements of wholesale and retail prices over time; the stickiness of institutional prices fixed by contracts and their resulting insensitivity to short-term variations; the unrepresentative nature of wholesale and contract prices based largely on London data, or on other specific locations (for example, regional workhouses); and the fact that the available series often relate to raw material prices, and may not reflect accurately the corresponding movements in finished product prices (for example, wheat used as a proxy for flour, or tallow for candles). One of the main aims of the research underlying the previous paper was to explore these issues. For the indicators used in the present cost of living index for food, coal and candles the conclusion was that these criticisms were not generally well-founded, although there are certainly some institutional and contract series to which they might be applicable.

The measurement of the price of clothing presents more difficult problems and discrepancies in the available sources were noted in the previous paper (Feinstein, 1995, 11, 16-18). Since that was published I have found some additional information on the costs of clothing and other writers have published more data on the costs of various types of cloth. For the present paper this additional evidence is incorporated in a revised index which also allows explicitly for the changing importance of cotton, woollen and linen fabrics (for further details see Appendix C).

This new cost of living index falls much less steeply in the post-1815 period than that constructed by Lindert and Williamson (1985).[15] A number of separate factors account for this, each relatively modest, but all tending in the same direction and thus cumulatively sufficient to have a significant effect. They include the lower weighting given by the new index to the exceptionally steep post-war fall in the price of cereals; the inclusion of additional items such as potatoes, milk, cheese and beer which either fell much less than other goods or actually increased in price in the period from the end of the war to mid-century; the much more modest fall post-1815 shown by the new index of clothing prices; the more marked increase in rents shown by my new nationally-based index; and the effect of the present procedure chaining three sub-periods with early-year weights in preference to using a single late-year base for the index.[16]

5. Trends in real wages

The new cost of living index and the index of full employment real earnings for workers in Great Britain are brought together in Table 5 to give a measure of the trends in real wages. The dominant feature is the extremely moderate rate of improvement in real earnings shown by this new series. From 1770 to the end of the Napoleonic Wars nominal earnings kept roughly in step with the cost of living, and there was no increase in average real earnings. After 1815 there was slow progress, but by the mid-1850s the level shown by the new index was still only 26 per cent above the pre-industrialization figure. On this new evidence it thus appears that it was only after that date that substantial and sustained advances in real wages were achieved by the average British worker.

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[15] Reference is to the revised version presented in response to criticism by Crafts (1985b) of their original index (Lindert and Williamson, 1983; 1985).

[16] See Feinstein (1995) for further discussion of these points.

Table 5. Indices of Average Full-time Nominal Earnings, the Cost of Living and Real Earnings, Great Britain, 1770-1882 (Five-year averages, 1770-1772 = 100)

	(1) Nominal earnings	(2) Cost of living	(3) Real earnings
1770-72	100	100	100
1773-77	103	109	95
1778-82	109	109	100
1783-87	109	107	101
1788-92	117	112	104
1793-97	140	133	105
1798-02	166	170	99
1803-07	187	167	111
1808-12	204	203	100
1813-17	200	191	105
1818-22	180	162	111
1823-27	171	151	113
1828-32	169	148	113
1833-37	171	138	123
1838-42	181	155	116
1843-47	185	150	123
1848-52	183	137	134
1853-57	208	165	126
1858-62	213	156	136
1863-67	228	160	142
1868-72	242	163	148
1873-77	271	162	167
1879-82	265	150	175

This estimate of the changes in the material aspect of living standards is thus markedly less optimistic than the corresponding estimate by Lindert and Williamson, which showed a rise of some 75 per cent between 1781 and 1851 (Table 6). This discrepancy is almost entirely due to differences in the respective cost of living indices, and - in particular - to the rate at which prices are estimated to have fallen from their war-time peak to 1850.

Table 6. Comparison with Lindert and Williamson Index, Real Earnings, 1781-1871 (1781 = 100)

	(1) Lindert and Williamson	(2) Present index
1781	100	100
1797	80	107
1805	103	112
1810	101	100
1815	105	105
1819	116	107
1827	131	113
1235	145	124
1851	174	135
1861	189	137
1871	210	153

(1) For 1781-1851 nominal full-time earnings for blue collar workers from Lindert and Williamson (1983, 7) deflated by their revised cost of living index (1985, 148), linked for 1851 -71 to Williamson (1985b), pp. 30 and 220. (Except for 1781 the cost of living estimates are centred five-year averages).
(2) Centred five-year averages for both nominal wages and the cost of living.

6. Three qualifications

There are now three qualifications and adjustments which must be considered in relation to this account of the trends in real earnings.

(i) Hours worked: The above estimates are all based on weekly earnings. The evidence on actual hours worked is very inadequate, but it seems probable that there was some reduction in hours per day, from perhaps 12 or slightly longer at the beginning of the period to something nearer 10 by the 1850s. This may, however, have been partially offset by a diminishing observation of St Monday, leaving little change in the total number of hours worked each week.[17] The net effect on hourly earnings and leisure is thus uncertain, and no adjustment for hours worked has been made.

(ii) Unemployment and short-time working: It is now time to drop the assumption of earnings based on full-employment. Two adjustments are incorporated, in an attempt to to allow for cyclical fluctuations in industry and for seasonal unemployment in agriculture.

For the cyclical measure employment in agriculture, domestic service and the armed forces is assumed to be broadly stable, so that the adjustment for unemployment is required only for building, mining, manufacturing and transport.[18] Faced with a lack of any worthwhile direct information on the extent of unemployment, any measure must necessarily be very rough. The starting point was the Gayer, Rostow and Schwartz index of the pattern of cyclical fluctuations between 1790 and 1850, extended to cover the years 1770-90 and 1850-60.[19] In this index each year is graded from 0 (deep depression) to 5 (major cycle peak), and these grades were then used as the basis for an estimate of the percentage of wage-earners out of work or on short time each year.

The conversion from business cycle grade to unemployment percentage is inevitably rather arbitrary, and was based largely on the information derived from trade union records for the second half of the nineteenth century showing the proportion of their members in receipt of benefit when out of work. Ad hoc adjustments to particular years were then made in the light of observations and comments in the business cycle literature on the character of the various cycles. This procedure generated an average level of unemployment in the period from 1770 to the end of the Napoleonic wars of about 5%, rising to about 8% in the period from 1815 to mid-century. This increase reflects the greater importance in the later period of the more volatile industries, and its effect is further enhanced as, with the expansion of the industrial sector, the higher percentage is applied to a progressively larger proportion of the labour force.

The problem of winter unemployment in the farm sector during the depression of agriculture following the end of the wars against France is well-recognised in the literature (for example, Fox, 1903, 297; Gash, 1935-6; Snell, 1985), but it is again extremely difficult to get any direct indication of the quantitative magnitudes. I have assumed that it applied only to hired labourers, not to farmers' relatives or to farm servants hired by the year; and only to those counties in which farming was predominantly arable. The excess of winter unemployment over the prevailing summer rate was taken as 10 per cent of the number of hired agricultural labourers. This was based on the estimates compiled by Boyer (1990, 89 and 132) from responses from a small sample of parishes to the Rural Queries distributed in 1832 by the Royal Commission on the Poor Law. This additional level was assumed to apply for the five months November to March in each year from 1815 to 1850, and then to have diminished steadily until by 1870 it was no longer significant.

(iii) The inclusion of Ireland: Immigration from Ireland was clearly a substantial element in the United Kingdom labour market and Irish wages should be brought into the overall picture. This applies particularly to agriculture, the only sector in which Ireland had both large numbers of wage-earners and a pattern of changes in earnings

[17] Bienefeld (1972), Reid (1976), Rule (1981), pp. 57-61, Hopkins (1982). I have also benefitted from unpublished work by Voth (1996) which will form part of his Oxford D. Phil dissertation.

[18] Any further loss of income as a result of sickness or persistent casual labour is assumed to be a broadly constant proportion of earnings each year and so does not affect the long-term trend in real earnings.

[19] Gayer, Rostow and Schwartz (1953) p. 356; the extrapolation to earlier and later years was based on Ashton (1959), Hoppit (1987) and Hughes (1960).

appreciably different from that in Britain. The earnings of Irish agricultural labourers can be incorporated using the index compiled by Bowley (1899) allowing for 'want of work'.[20]

The results of these two adjustments can be seen in Table 7. The effect of the allowance for unemployment and short-time working as measured in column 2 varies with the impact of the trade cycle in any given period relative to 1770-72. For the five years centred on 1850 it is relatively large: sufficient to reduce the increase in real earnings since 1770 by five percentage points from 34 per cent to 29 per cent. When Ireland is included (column 3) there is a further reduction of 6 percentage points to only 23 per cent.

Both these adjustments are less powerful in the subsequent five-year period centred on 1855, when there was a boom in economic activity and Ireland was recovering from the disasters of the famine years. However, the steep rise in prices during the upswing of the mid-1850s eroded much of the gains in real earnings in the preceding five years (see Table 5), cutting the increase since 1770 to 26 per cent. The allowance for unemployment shrinks this by one percentage point, and the inclusion of Ireland takes off a further three percentage points, leaving an advance of only 22 per cent.

The overall result is thus that real weekly earnings allowing for unemployment were some 25 per cent higher in the mid-nineteenth century than in the early 1770s. It is not possible to calculate exact statistical confidence intervals for a calculation of this nature, but a subjective assessment of the likely margins of error in the estimates of average nominal wages and the cost of living points to a probability (at the 95 per cent level) that the true value of the improvement might be as little as 15 per cent or as much as 35 per cent. An increase within this range would cover the experience of both Great Britain and the United Kingdom, and would probably also apply to the improvement in hourly as opposed to weekly earnings.

Table 7. Real Wages Adjusted for Unemployment and for the inclusion of Ireland, 1770-1882
(Five-year averages, 1770-72 = 100)

	(1) Full-employment real earnings (Great Britain)	(2) Real earnings adjusted for unemployment (Great Britain)	(3) Col (2) adjusted to include the earnings of Irish agricultural labourers
1770-72	100	100	100
1773-77	95	94	94
1778-82	100	98	97
1783-87	101	101	99
1788-92	104	103	100
1793-97	105	103	100
1798-02	99	99	94
1803-07	111	110	104
1808-12	100	98	93
1813-17	105	101	95
1818-22	111	107	100
1823-27	113	110	102
1828-32	113	109	101
1833-37	123	120	110
1838-42	116	111	103
1843-47	123	120	113
1848-52	134	129	123
1853-57	126	125	122
1858-62	136	134	134
1863-67	142	140	141
1868-72	148	147	149
1873-77	167	166	171
1879-82	175	171	178

[20] In his estimates for Ireland Bowley attempted to cover not only the earnings in cash and kind of full-time and casual hired labourers but also those of farm servants, of cottiers (who obtained part of their earnings in the form of a house and an area of land at a reduced rent), and of those who worked for their landowners as the means of paying rent for their land under the *con-acre* system.

This picture of a very slow improvement in the average real wage during the first half of the nineteenth century may be thought to conform rather better with qualitative accounts of conditions in both rural and urban areas in this period than the markedly more optimistic interpretation implied by the Lindert and Williamson series.[21] It is consistent with theoretical models of the behaviour of nominal earnings in an economy in which there was rapid population growth as well as the vast reservoir in rural Ireland, effectively creating an unlimited supply of labour in the countryside.[22] Given this excess supply of rural labour in conjunction with the other factors noted earlier - innovations in the hand-tools used for harvesting wheat and the post-war collapse of farm prices - agricultural earnings dropped steeply until the end of the 1820s and were subsequently unable to advance by more than a very modest amount.

The rural surplus in turn helped to keep down urban wages, and this pressure was exacerbated in many sectors as skilled male craftsmen were displaced or challenged by the introduction of machinery, by the employment of female workers in traditional male occupations such as the weaving of woollen cloth, and by changes in the organisation of production, for example in the manufacture of clothing and footwear, which undermined the traditional position and organization of the skilled male journeymen.

The very modest progress revealed by the present estimates is also consistent with other indicators of an abundant supply of unskilled labour; for instance, the ease and speed with which the huge number of navies was obtained to construct the railways in the 1840s (Mitchell, 1964, 322-3; Hawke, 1970, 327); or the fact that it was not the 1850s that the Army began to experience serious problems of recruitment and initiated a succession of measures to improve the infantryman's basic gross pay of 13d. per day which had prevailed since 1797 (Skelley, 1977).

It might also be suggested that the slow growth in average real earnings revealed by the present estimates makes more sense of the persistence of the standard of living controversy itself. The debate would surely not have been so protracted if the outcome had clearly been as unambiguously favourable to the workers as claimed by Lindert and Williamson. From this alternative perspective it can be seen that it was the unfortunate position of those sectors and regions which fell behind the modest improvement in the average which sustained the case of both contemporary and modern writers in arguing for a pessimistic interpretation.

Farm labourers in the southern counties of England and Wales and certain of the former craftsmen and skilled journeymen were among those who experienced an actual deterioration in their material conditions in the first half of the nineteenth century. However, even if they escaped this fate, the new estimates suggest that most of those at work in the 1770s would have derived very little benefit from the industrial revolution during their lifetimes, and even those who started their working life after 1815 would typically have had to wait some four decades before seeing any significant improvement.

7. Real wages and per capita GDP, Great Britain, 1780-1830.

We come finally to the second of the two debates mentioned at the outset. What light can the new estimates of average real wages throw on the rate of growth of the British economy during the industrial revolution? The estimates for Great Britain, including the adjustment for unemployment, are compared in Table 8 with the series for real GDP per head by Deane and Cole and by Crafts. The rate of growth in real wages shown by the new series over the fifty year-period 1780-1830 is marginally slower than the growth of real GDP estimated by Crafts, and is thus even further below the original Deane and Cole estimates. At this aggregate level the new estimates thus offer no support for the attempt by Cuencas Esteban to reinstate the traditional pattern of sharp acceleration in overall economic growth.

Table 8. Growth of Real Wages and Real GDP per head, Great Britain, 1780-1831 (Annual percentage growth rate)

	(1) 1780-1801	(2) 1801-1831
Real GDP per head:		
Deane and Cole	1.08	1.61
Crafts	0.41	0.45
Real wages:		
Present estimate		

[21] See, for example, the discussion in Habakkuk (1962) pp. 132-88 and Pollard, (1978).

[22] See, for example Lewis (1954). It should be noted, however, that Williamson (1985a) explicitly rejects the proposition that the Lewis model is applicable to the British labour market in this period.

Full employment	-0.09	0.41
Adjusted for unemployment	-0.06	0.29

Source: See Table 1 and text.

One probable reason for the differences in Table 8 is, of course, the presence of measurement errors in all three sets of estimates, and the real wage series are still provisional. However, there is a conceptual difference between average real wages and per capita real GDP, and it is necessary to consider how this might affect the comparison. This difference can be expressed in terms of the following simple identity, derived from two alternative definitions of the total wage bill.

$$w.N_w \equiv \alpha.Y$$

$$\frac{w}{P_w} \equiv \frac{Y}{P_y.N}.\alpha.\frac{P_y}{P_w}.\frac{N}{N_w}$$

In the first row total wages are defined on the left as the product of the average wage (w) and the number of wage-earners (N_w), and on the right as the share of aggregate wages in GDP (α) multiplied by GDP (Y). The average wage is then deflated in the second row by the cost of living index (P_w) and aggregate income by the GDP deflator (P_y) , and the latter is also divided by the total population (N) to give real per capita GDP. The remaining terms preserve the consistency of the initial identity. This enables us to specify the three factors which differentiate the rate of growth of average real wages and of per capita real GDP.

The first is α, the share of wages in national income. The rate of growth of real wages would be less than that of per capita real GDP if there was a fall in α, i.e. if other components of national income increased more rapidly than wages. It is possible that there was such a redistribution of income, with landowners and businessmen gaining relative to wage-earners during a period of rapid advances in rents and profits, especially during the war-time years, but any such shift is unlikely to have moved labour's share more than a few percentage points.[23]

The second factor is the relative price, P_y/P_w. Average real wages would increase less rapidly than per capita real income if the price of all goods and services fell relatively to those making up the cost of living index. This would have occurred if, for example, there was an unfavourable movement in the net barter terms of trade so that export prices fell more rapidly than those of imported and home-consumed goods. There is considerable uncertainty about the movements in the terms of trade, but it seems likely that there was such a deterioration, at least for second period covered in Table 8, from 1801 to 1831.[24] Given the rapid growth in exports of the products of the revolutionary cotton industry it is likely that an appreciable part of the gains from technological advances in British industry were enjoyed by foreign consumers.

The final term is the ratio of the total population to the labour force (N/N_w, the reciprocal of the participation rate). A downward trend in this ratio would again reduce the growth of average wages relative to the growth of per capita GDP. In fact, however, this particular trend went the other way. The proportion of the population of working age was falling during the period of rapid increase in birth rates, and even though there was probably a rise in the proportion of women in the occupied labour force the number of dependants per worker was rising in these years, not falling.[25]

In order to reinstate the account of the pattern of rapid growth indicated by the Deane and Cole estimates it would thus be necessary to demonstrate that there was a substantial fall in the share of wages in the national income and/or a substantial rise in the relative price of wage goods to an extent sufficient both to offset the adverse effect on per capita incomes of the rising number of dependants, and to raise the rate of growth by a substantial margin. The research necessary to measure these effects has still to be completed, but preliminary indications do not suggest that they were sufficiently powerful to close the gap between the present growth rates and those calculated by Deane and Cole.

There thus appear to be three major conclusions to be drawn from the present results. First, the improvement in the material standard of living of manual workers as measured by average real wages was negligible before 1815 and very modest until after the middle of the nineteenth century. Only after 1861 was there a sustained improvement in all the major sectors.

Secondly, the implications for the overall growth of the economy of these income-based estimates of real wages are consistent with the results derived by Crafts and Harley from completely independent output-side data.

[23] Deane and Cole (1961) p. 251.

[24] Imlah (1958) pp. 93-109; Deane and Cole (1962) pp. 82-8.

[25] Wrigley and Schofield (1981) p. 529; Horrell and Humphries (1995).

They do not support the attempt to re-establish the classic view of the industrial revolution involving a sharp acceleration to a high rate of growth in per capita real GDP before 1830. This does not, of course, preclude dramatic changes in individual parts of the economy.

Thirdly, there are still a number of serious weaknesses in the quantitative record, and there is considerable scope for further research, measurement and analysis before we can be confident that the trends in British economic growth over this crucial period have been accurately measured.

APPENDIX A

Estimates of full-employment weekly earnings, Great Britain, 1770-1881

The aim in this appendix is to provide brief notes on the sources and methods of estimation adopted for each of the sectors for which estimates of annual earnings have been made for the period 1770-1881.

Agriculture

This index combines two separate series covering the weekly cash earnings of ordinary adult male and female hired labourers in England and Wales, and a third for male labourers (including farm servants) in Scotland. For England and Wales total earnings (including allowances in kind, payments for piecework and overtime, and extra money paid at harvest) maintained a roughly constant ratio to weekly cash wages (Bowley, 1899, 556; Fox, 1903, 282-90). For Scotland Bowley incorporates benchmark estimates of the payments in kind to married ploughmen.

From 1770-1850, and for Scotland throughout, the index for males is based on Bowley (1899, 562-4, three-year averages); from 1850 to 1881 his estimates for England and Wales were replaced by an index constructed from the wages paid on a sample of farms (Fox, 1903, 331-2; Department of Employment, 1971, 38). There are some differences between the Fox and Bowley series where they overlap for the post-1850 period, and the former has been preferred on the grounds that data collected on a consistent annual basis from a sample of farms (even though the number covered is very small) was likely to provide a more accurate indicator of change than the successive independent surveys which are the basis for Bowley's index.[26]

For female outdoor farm labourers in England and Wales it was possible to obtain benchmark estimates for four years. Interpolation between these points was based on the index for male wages. The resulting series is clearly very imperfect, but allows for the relative decline in womens' pay in the late eighteenth and early nineteenth century, and does broadly indicate the trends in the earnings of a previously neglected group of wage-earners.

For 1770 estimates were assembled for some 72 villages from the information on average weekly pay for male and female labourers at different seasons of the year collected by Young on his various tours (Young, 1770, 447-9; John, 1989, 1075-9). Following Young's procedure annual averages were obtained on the basis that the harvest rate was paid for five weeks, the haytime for six, and the winter for 41; where winter rates were not given the average for the summer weeks was calculated. Because the villages for which Young provides data were predominantly in the North, the figures were grouped by county, and a national estimate was derived as an unweighted average of the 27 counties represented in the data set. The result for average weekly female earnings is 3/6 for the full year and 4/9 for the summer weeks, in each case about 50 per cent of the equivalent male pay in the same set of villages.

For 1833 similar data on male and female wages was extracted from the parish replies to the Rural Queries distributed in 1832 by the Royal Commission on the Poor Law (PP 1834 XXX-XXXIV). In total over 300 parishes provided usable information on summer or annual wages, and this was again averaged by county to obtain an overall estimate of average annual weekly female wages of 4/2, 39 per cent of the corresponding figure for men. This level is consistent with the estimates of 8d to 9d per day by Hasbach (1908, 227) and Pinchbeck (1930, 88) based on information gleaned from the *Report on the Employment of Women and Children in Agriculture* (PP 1843 XII).

Data for the two final benchmarks is more readily available in the results of parliamentary enquiries summarized in the *Returns of Wages* (PP 1887 LXXXIX, 411-19) for three quarters in 1860-61 and four in 1869-70. The annual average for the earlier date is 4/6 per week, equal to 40 per cent of the figure for men, and for the later date 5/2, equal to 41 per cent.

Mining

The index is based on a series for coal hewers' shift earnings which is taken as representative of the trends in all mining and quarrying . For 1800-81 I have used the estimates by Mitchell (1984, 194-5). To interpolate for the years in the early part of the nineteenth century not covered by Mitchell's data, and to carry the series back to 1770 I have relied on scattered and very imperfect indications in Bowley (1900, 101-09),

[26] See further, Feinstein (1990) p. 616.

Hamilton (1926, 312-6), Jenkin (1927, 132-40, 171, 199 and 205), Ashton and Sykes (1929, 134-41), Dodd (1933, 337-44), Langton (1979, 117 and 201-9), and Flinn (1984, 386-95).

Building

This covers the main building trades and also work on the construction of the railways. For the former, Bowley (1901, 107-12) gives annual estimates from 1830 for wages of both craftsmen and labourers in a range of towns, and makes an allowance for changes in the relative importance of the different towns included in the index. For earlier years his overall index is given only in the form of average levels for four sub-periods from 1795 to 1830, though more information is given for individual towns. The present index is based on Bowley for the period from 1795, and was extrapolated to 1770 by making a weighted average of indices for building craftsmen (weight 1) and labourers (weight 2). The former is based on series for London, Lancashire, Kent, Gloucester and the Midlands; the latter includes these regions and also the North Riding. These series were taken from Gilboy (1934, 254-87) and Eccleston (1976).

For railway construction labour I have used an unpublished index generously made available by Brian Mitchell. This was compiled in connection with his estimates of railway capital formation (Mitchell, 1964).

Engineering and shipbuilding

From 1794 onwards we can rely on the enormous mass of information assembled from trade unions, employers, and official and private enquiries by Bowley and Wood (1906, 185-190). Their index covers a wide range of skilled, semi-skilled and unskilled labourers in engineering and machine-shops, iron foundries, boiler-shops and shipyards in a large number of inland and maritime centres. It allows for changes in the composition of the labour force and for the effects on weekly earnings of various piece rate systems.

For the late eighteenth century the few comparable estimates which I could find point to an increase in weekly earnings for millwrights and mechanics from about 12 or 13 shillings to around 18 to 20 shillings between the 1770s or 1780s and the late 1790s. For shipwrights the level of pay was higher but the increase was also roughly 50 per cent or a little more (*Return of Wages*, 1887, 33; Bowley, 1900, 60; Bowley and Wood, 1905, 115 and 136; Ashton, 1924, 189-93; Mantoux, 1928, 432-3; Daniels, 1929, 593; Rule, 1981, 18). This is broadly in line with the increase in the series for building craftsmen described above, and the index was extrapolated back to 1770 by means of this series.

Cotton textiles

For the period from 1806 Wood has worked exhaustively through the mass of information available for the multitude of different occupations in the cotton industry, and his index (Wood, 1910, 598-9) is carefully weighted to allow for the changes in the composition of the labour force by occupation, sex and age, and for the changing importance of the different sectors.

Completion of the index for the period before this is very much more difficult. The present estimate attempts to do this by taking a weighted average of series for spinners and handloom weavers, with the latter given twice the weight of the former; and is intended to cover workers both at home and in the factories. For the spinners see Table 2 and the related discussion on p. 6 above. For the hand-loom weavers it is again possible to rely mainly on Wood (1910, 425-33 and 593-6). He gives annual estimates of their weekly earnings from 1797 onwards, showing a figure of 18/9 at that date, and also quotes estimates from Arthur Young and others for the 1770s and the later decades of the eighteenth century.[27] A starting point of 6.25 shillings in 1770 and 6.5 shillings in 1778 was adopted on the basis of the figures Wood quotes, and his comments on these. I have then assumed that handloom weavers earnings rose rapidly to 18 shillings a decade later, and were steady at that level during the famous ‘golden age’ when rapidly increasing supplies of cheap yarn created a surge in demand for the services of the weavers. The series then moves up a fraction from 1795 to meet the figures given by Wood.

Woollen and worsted textiles

Both Bowley and Wood tackled the problem of measuring earnings in this industry and provide valuable information, but Wood criticised his colleague's original estimates without himself producing a final index on the lines of his masterly study of the cotton trade.[28] It is not difficult to understand this, given the complexity of the industry, the changes in the composition of the labour force, and the lack of hard information until well into the nineteenth century. Nevertheless, it seemed better to include even a rough estimate rather than to omit the changes in earnings in an industry which was of such importance in the eighteenth century and which was

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[27] See also Bowley (1900) pp. 110-13 and Unwin (1924) pp. 110-14.

[28] See Bowley (1902) but note the partial retraction in Bowley (1937) p. 9. Wood published his own indices for Huddersfield and Bradford in a number of papers, but without ever describing his sources and methods; see, for example Wood (1909a; 1909b). It is possible that they were based in part on information collected from 50 firms in a Labour Department enquiry with which Wood was associated but which was never published; see ‘Woollen and Worsted Wage Enquiry, 1839-1907’, PRO, LAB 41/61. On occasion Wood also reproduced Bowley's series for Leeds, but its absence from his 1909 table, and thus presumably from his own overall index, suggests that he may not have fully endorsed it; see Wood (1910), p. 618.

subsequently the subject of revolutionary technical changes, albeit at a slower pace than in the manufacture of cotton.

The present index was compiled separately for 1770-1830 and 1830-1881. For the latter period the movements in earnings in all branches of the woollen and worsted industry are represented by estimates for Leeds, Huddersfield and Bradford for selected years by Wood (1909a, 93; 1909b, 75) and Bowley (1902, 117). To obtain an annual series it is necessary to interpolate between their selected years; since these are simply the years for which information was available in one or other of their sources, I have generally assumed smooth growth between the benchmarks. So far as the changes in average levels were the outcome of changes in the composition of the workforce - for example, the gradual displacement of men by women in the weaving of woollen cloth - this smoothness may be justified, but the detailed figures could probably be improved by closer study of the trade fluctuations in the industry.

The resulting series for Leeds (weight 1) and Huddersfield (weight 2) were combined to give an index for wool; and the index for Bradford was taken to represent the worsted sector. The values for the woollen and worsted sectors were then combined in a weighted average, with the share of the former declining from about 80 per cent in 1835 to 55 per cent in 1861. The weights were based on employment in the two sectors as shown by the *Factory Returns*, but with an adjustment based on the Census of Population data on occupations to allow for the fact that a greater proportion of the woollen trade was still conducted at home in the first half of the nineteenth century (Baines, 1970, 88-92).

For 1770-1830 I have proceeded on the same lines as for cotton. For the handloom weavers a very rough index was pieced together from the few wages quoted, combining series for woollen cloth (weight 4) and for worsted stuff (weight 1) derived from Bowley (1902, 106-8 for Bradford; 1902, 112-4 for Leeds; 1900, 113-4 for Somerset and Gloucester), Palgrave (1926, 634-5), Bischoff (1842, II, 416-9), Lipson (1921, 256-60) and Mantoux (1929, 435). For spinning the index is based on a roughly weighted average of estimates aimed at reflecting the changes as hand spinning by women working at home was superseded by the introduction of the jenny, operated by both men and women, and the jenny was in turn replaced in the late 1820s by male-operated mule spindles. The main sources were Bischoff (1842, II, p. 416), Bowley (1902, 112-6), Lipson (1921, 258-60), Palgrave (1926, 634) and Pinchbeck (1930, 141). The overall index for the woollen and worsted industry was then obtained by combining these two indices for spinning (weight 2) and hand loom weaving (weight 1), and linking this to the corresponding index for 1830-81.

Clothing and footwear

Two indices were compiled in order to cover at least part of this large industry, one for tailors and the other for boot and shoe-makers. It is likely that both provide a broadly acceptable measure of the overall trend in earnings, but there is insufficient information to make accurate estimates of short-term changes or of the changing importance of the trade in different centres.

The index for tailors is intended to cover the average earnings of both men and boys, but is based largely on figures for journeymen tailors. The main sources are Galton (1896, 147), Porter (1847, 457); George (1925, 163-5 and 368), Palgrave (1926, 634-5), Mayhew (1980, 2, 72-149) and the *Returns of Wages* (PP 1887 LXXXIX, 392). The series for boot and shoe makers covers both men and women. The main source for the period after 1830 is the information for a number of towns given in the *Returns of Wages* (PP 1887 LXXXIX, 253-9) and Department of Employment (1971, 37). For earlier years the index is based mainly on the wages quoted in Porter (1847, 457), Palgrave (1926, 634-5) and Mayhew (1980, 3, 111-203).

Printing

Bowley and Wood (1899, 708-15) give an index based on the weekly time wages of compositors employed on book and jobbing work from 1777 to the end of our period. It is a weighted average of the various towns for which figures are available at different dates, but makes no allowance for any changes in the structure of the printing industry, for example, between book and jobbing work and newspaper printing, though the effect of such changes was thought to be small before the 1880s.

Pottery

An index of money earnings of skilled potters in North Staffordshire has been compiled by Botham (1982; see also Hunt and Botham, 1987). It is based on information drawn from surviving account books and firm records, parliamentary enquiries, newspapers, trade union records, and arbitration proceedings. There is a gap in the series between 1770 and 1790 and this was bridged by assuming a linear increase.

Merchant Seamen

The index is based on the wages in cash and kind of able seamen, and it is assumed that there were no significant changes in the composition or age structure of the crews. For 1840, 1850 and 1861-81 Bowley (1895, 266-9; 1898, 482) constructed an index of cash earnings weighted to allow for the gradual transition from sail to steam. Interpolation for the intervening years was based on the rates for seamen on foreign-going vessels from London and Liverpool given in the unpublished collection of data assembled by Wood for the Board of Trade

(1908, 290). For 1817 to 1833 the index relies on continuous series for three voyages, broadly consistent with the later figures, reported by a shipowner to a Select Committee (PP 1833 VI, p. 480).

Starting at the other end of the period we can obtain good estimates from the research into shipping records by Davis (1962, 137-45) for the eighteenth century, supplemented by figures quoted by Bowley (1900, 77-9) and Ashton (1955, 226). The main source for the extent of the very large movements in earnings during the war years is the evidence of shipowners and brokers to the 1833 Select Committee (PP 1833 VI, Qs 3597-601, 6175-82, 7864-5).

The value of the food supplied to seamen was estimated by Giffen to be worth about 33 shillings per month in the 1880s.[29] If this is adjusted to 1770 prices it comes to some 23 shillings, whereas the figure given for that period by Davis (1962, 145) is only 17 shillings, presumably reflecting the lower standard of the ordinary seamen's victuals in the late eighteenth century. An annual estimate was obtained by interpolating between the 1770 and 1880 benchmarks on the basis of the cost of living index, with the improvement in standards introduced gradually over the course of the intervening years.

Railways

This index covers porters, guards, shunters, drivers, firemen and other wage-earners employed in railway occupations in goods and passenger traffic. Other employees of the railways (for example building or engineering workers or carters) are included with those occupations; railway clerks and station masters are treated as salaried workers. The main source for the movements in pay on the railways is the data assembled by Kingsford (1970, 88-115); there is also an unpublished return submitted by the railwaymens' trade union, which gives scales for a few towns for the 1870s and 1880s.[30] The various categories were weighted according to the numbers employed in England and Wales as given in the *General Report* on the 1886 census of earnings (PP 1893-4, LXXXIII, 266-7).

Other transport and storage

This covers a variety of wage-earners employed on canals and docks; as carters carmen, coachmen and in other forms of road transport; as warehousemen and women, and as messengers. A very rough measure of the wages paid at various dates in each of these occupations was derived from the 1887 *Returns of Wages* and other sources (George, 1927, 246-7; Oram, 1970, 84-5, 189). The separate series were then combined in a single index for the period from 1800, and this was extrapolated back to 1770 by means of the index for building labourers described above.

Domestic servants

Separate indices were compiled for female and male domestic servants. The information available for the earnings of the very large group of female wage-earners is severely limited, and it is impossible to allow accurately for the many categories from senior cook to lowly scullery maid, for the differences in payment in various parts of the country, or the for possible effects on the average of changes in earnings with age and length of service. The numbers engaged in this sector are so large, however, that it is worthwhile attempting to form a rough indication of the changes in cash wages and in the value of board and lodging. Many of the sources refer to large establishments and are useful in indicating both changes over time and the dispersion of earnings across the different types of servant, but the level of these payments is well above the average for all households.

For the cash wage the basic procedure for 1825 to 1881 was to interpolate between estimates for three benchmark years. For 1881 a figure of £14.1 was derived in previous work (Feinstein, 1990, 626-8). For a mid-century benchmark a classification of female domestic servants by occupation and age was made using data from the 1851 Census of Occupations (PP LXXXVIII, Pt I). Cooks, housekeepers, nurses and housemaids, accounting for 22 per cent of the total, were each sub-divided into three age-groups (under 25, 25-40 and over 40), and the larger number of general servants, 78 per cent of the total, was split into seven age-groups. An estimated cash wage was then assigned to each of these 19 categories, using information on domestic servants from *Edinburgh Review* (1862, 426), Layton (1908, 518-22), Clapham (1934, 33) Banks (1954, 71-6), Horn (1986), and Peel (1926, 164-87; 1934, 104-7 and 143-51), and on wages paid to nurses in hospitals and asylums in Abel-Smith (1960, 5-7 and 279) and *S.C. on Lunatics* (PP 1859 III). This yielded a weighted average of £9.1 for 1850. Interpolation between 1850 and 1881 was based largely on the indices in Layton (1908).

For 1825 a figure of £7 was adopted, partly on the basis of extrapolation by means of Layton from 1850, partly on the sources listed above, together with (Adams, 1825, 234-97), *A New System* (1825, 424-49) and Pinchbeck (1930, 36). This estimate was then extrapolated to 1770 (£4.6) by reference to the extensive

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[29] PP 1893-94 LXXXIII Pt II, p. xxii; Giffen's estimate of £20 p.a was based on the difference between seamen's wages paid with and without food.

[30] PRO, LAB 41/25. A representative of the Labour Department of the Board of Trade recorded his view of this data with the comment: 'I thoroughly distrust this scrappy return', but the figures are broadly consistent with those given by Kingsford.

collection of earnings given in Hecht (1956, 146-49) and the series for female wages in St Clement Danes given by Snell (1985, 416).[31]

For board and lodging there is consistent evidence of a figure of around 10 shillings per week in the late nineteenth century (Feinstein, 1990, 628) and it appears to have been much the same as this in the middle of the century (*Edinburgh Review*, 1862, 423; Banks, 1954, 73;). In 1825 this was also quoted as the figure for a large establishment 'when the family is absent' (Adams, 1825, 8). However, the writer in the *Review* mentions that 'in the dear days of war and corn-laws the board wages in London were 6 shillings per week for the women', while Pinchbeck (1930, 313) quotes a witness before the Factory Commission in 1833 who said that a girl who left home would have to pay 5 shillings a week for board, lodging and washing. Hecht (1956) quotes weekly board wages for a few maids in the late eighteenth century, for which the average is also about 6 shillings.. There is also some evidence on the maintenance of apprentices at Quarry Bank Mill (Rose, 1986, 107) and at Oldknows (Unwin, 1924, 173), and of the inmates of poor law institutions and asylums. The value of farm servants' board was reckoned by Young (1770, 509) to be about 4 shillings in 1770, and Marshall put it as rising to about 6 shillings in 1794-6 (quoted in Armstrong and Huzel, 1989, 729).

In the light of these figures the average weekly cost was taken to be 4 shillings in 1761, adjusted at twenty-year intervals to 5, 7, 6, 7 and 9 shillings, and finally to 10 shillings in 1881. Other years were obtained by interpolating between these estimates by means of the cost of living index.

The corresponding index for the smaller number of male domestic servants was derived in similar fashion from the same sources, but with the advantage that the majority of males were employed in the large households to which much of the surviving evidence relates. The main sources can thus be accepted with less adaptation than was required for their female counterparts. The benchmark for the series was an estimate for 1886 derived from the data in Giffen's *General Report* on the 1886 wage census (PP 1893-94 LXXXIII, Pt II, 457). In calculating the average the small number of house stewards and other servants paid more than £140 per annum were excluded as being more appropriately treated as salaried employees. At the beginning of the period vails from house guests and visitors were an important part of the income of servants, but these are regarded as transfer payments, not as *part of their earnings.*

Army

The estimate covers the pay and allowances of privates and non-commissioned officers in the infantry, cavalry and artillery. The pay includes deferred and good-conduct pay, and the allowances cover clothing, provisions, accommodation, fuel and medical attendance so far as these were not paid for by deductions from pay. The starting point was a figure of £48.2 in 1878 based on an official estimate (P.P. 1878 XLVII, 2).

This was then extrapolated by an index based on movements in the pay and allowances of infantry privates. The basic pay was static for long periods, and the main changes are noted in parliamentary reports and enquiries (see especially PP 1830 XVIII, 96-7; PP 1871 XXXIX, 37; PP 1892 XIX, Q14,317), and a very informative paper by Tulloch (1863).

Navy

This series covers the pay and allowances of seamen, stokers, artisans, and others below the rank of warrant officers, including petty officers such as gunners, carpenters and boatswains. The starting point is an estimate prepared by the Admiralty for the *General Report* on the 1886 wage census (PP 1893-94 LXXXIII, Pt II, xxiii-xxiv). This gives benchmarks of £42.65 for the average annual pay of some 39,000 men in the Royal Navy, and of £22.10 for the estimated annual cost of allowances including provisions.

The figure for pay was extrapolated by means of a weighted average of three series for able seamen (weight 3), ordinary seamen (3) and petty officers (2). These were based on information about the relatively infrequent improvements in pay, with adjustments to cover the introduction of good-conduct bonuses and the reduction involved in the switch from lunar to calendar pay-months in 1852 (Lewis, 1960, 293-305 and 1965, 210-5; Lloyd, 1968, 248-50, 271).

The series for provisions was compiled from estimates of the expenditure per man derived from parliamentary reports (see especially, PP 1817 IV, 183 and App. 17) and the *Navy Estimates.* No evidence was found for the years before 1792, and the series was extrapolated from there back to 1770 by reference to the cost of living index.

General unskilled labour

This index is designed to cover the large number of unskilled labourers who were not assigned to specific occupations in the occupational censuses. The majority were probably employed in manufacturing industries and are included with that sector in Table 3. A rough index was constructed on the basis of information included

[31] Keith Snell has advised me that this series includes but is not limited to domestic servants, and that some of the variation may reflect age differences and payments of board wages. I have tried to minimize these problems by using the series only for the period 1766-1820 when the average sample size in each five-year period is 24 women.

in the 1887 *Returns of Wages* for labourers employed a large range of different towns and manufacturing industries, and on data in Eden (1795), Young (1770) and other sources.

APPENDIX B

Estimates of the Occupied Labour Force in Great Britain, 1771-1881

The total occupied population

Estimates of the total occupied population of Great Britain at decennial intervals were compiled in two stages, the first covering 1841-81, the second 1771 to 1831.

The first reasonably accurate census of the whole occupied population was taken in 1851, and the census data are used for 1851 to 1881.[32] For 1841 the census information appears to be broadly reliable for males aged twenty and over, but the returns for women and children are clearly incomplete. I have corrected for this by assuming that the proportions of females and of males under 20 to adult males was the same in each sector as in 1851, except for female domestic servants where the number returned appears to be about right.[33]

Many retired workers were returned in the 1851 and later censuses as part of the occupied population, and should be excluded from the estimated number of income-earners. The extent of retirement in this period has been a matter of some debate, but the consensus seems to be that the very limited provision of pensions compelled most workers to continue in employment for as long as they could.[34] Some 6 per cent of the occupied males were aged 65 and over in 1851, and I assumed that the full-time equivalent of one-third of these men, or about two per cent of the total occupied male population, were no longer in work.[35] The same proportion was adopted for the female labour force. With this adjustment for 1841-81 we have the final benchmarks for the number of occupied males and females.

In order to obtain labour force estimates for earlier years participation rates for males and females were applied to corresponding estimates of the population aged 15 and over. The starting point was a series obtained from Wrigley and Schofield (1981, pp. 528 and 595) for the population of England in the relevant age range at ten-year intervals from 1771 to 1851. This was raised to include Wales and Scotland, assuming in each case that the proportion of the population in this age group was the same as in England.[36] This series was then subdivided into males and females on the assumption that the sex ratio for those aged 15 and over was constant over the whole period at the level shown in the census returns for 1841 and 1851.[37]

For males the ratio of the total number occupied to the population aged 15 and over was found to be 1.01 in both 1851 and 1841; for females it was 0.395 in 1851 and 0.425 in 1841.[38] For males there is little scope for error in assuming a constant proportion for all years back to 1771. For females the position is much more problematical. It is frequently suggested that one effect of the industrial revolution was to diminish the employment opportunities for women, but the extent of any such decline is highly uncertain.[39]

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[32] Higgs (1987, 1995) has been a persistent critic of the census data on occupations, particularly for female workers, but they remain the most reliable basis available for aggregate estimates. Furthermore, some of his proposed corrections would change the classification but not the number of wage-earners (for example, the suggested inability of the enumerators to distinguish accurately between domestic and farm servants); and the inclusion of additional working wives or other female relatives omitted by the census enumerators would increase the number of occupied persons but would not change the aggregate family remuneration currently attributed solely to the male breadwinner.

[33] For this purpose I used the detailed classification of the occupied population by occupation, age and gender made by Booth (1886). Here and elsewhere I have accepted his classification of the employed population except for the exclusion of his final category of 'property owning and indefinite'. The distinction between a classification by industry and by occupation is rather blurred in the early period, and since the number of clerks - and others with occupations shared by different industries - was still relatively small, we need not be too concerned by this problem.

[34] See the discussion in Hunt (1989).

[35] This is consistent with the correction suggested by the Registrar-General in his comment on the issue in 1881; Census of England and Wales, *General Report*, 1881, pp. 28-9.

[36] A further adjustment was then made for Scotland to cover members of the army, navy and merchant marine wholly or partially omitted in the censuses for 1801 to 1851; see Wrigley and Schofield (1981) p. 592 for the corresponding correction to the census figures for England and Wales.

[37] The census figures were adjusted to cover the omitted men in the armed forces and merchant marine; the resulting proportions are 0.485 male; 0.515 female.

[38] The male ratio exceeds unity because the occupied population includes some 420,000 boys aged 10-14; excluding these the 1851 ratio was 0.96. The corresponding adjusted ratio for females was 0.37.

[39] The classic investigation is Pinchbeck (1930); for more recent studies see Richards (1974), Berg (1987), Hill (1989), Blythell (1993), and Horrell and Humphries (1995).

In recognition of the possibility of such a trend it is assumed somewhat arbitrarily that the female participation ratio was 0.48 before 1801, and then declined slowly to 1831 and more steeply from there to 0.395 in 1851. The effect is to make the number of occupied women roughly 200,000 (13%) higher in 1801 than it would have been if the 1841 ratio had been applied in all previous years. The resulting total of 1,700,000 occupied females in 1801 should be thought of in terms of full-time equivalents; the total number of women engaged part-time in farming, spinning, weaving and other activities which they combined with unpaid labour in the home was, of course, considerably larger.

One way of interpreting the estimates might thus be to treat one part of the estimated female participation ratio in 1801 (say 0.40) as representing actual full-time workers and the remaining part (0.08) as representing full-time equivalents. If, as an average, the latter group of women were working one-third of full-time (equivalent to two days per week) this would mean that some 64 per cent of all women were engaged in paid activity, a proportion which would be broadly in line with the results obtained in a quite different manner by Horrell and Humphries (1995, p. 98) for the period 1787-1815. Despite this potential consistency, the estimates for the female labour force must still be regarded as exceptionally tentative, and further investigation of this issue is a high priority.

The estimates of the occupied labour force derived on this basis are shown for 1771-1851 in the upper panel of Table A1.

Table A1. Total Male and Female Occupied Population and Wage-Earners, Great Britain, 1771- 1851 (millions)

	1771	1781	1791	1801	1811	1821	1831	1841	1851
Total occupied population									
Male	2.72	2.87	3.10	3.38	3.81	4.32	5.00	5.89	6.63
Female	1.37	1.45	1.56	1.71	1.88	2.09	2.37	2.60	2.75
Total	4.09	4.32	4.66	5.09	5.69	6.41	7.37	8.49	9.38
of which **Wage-earners**									
Male	2.20	2.33	2.50	2.74	3.13	3.48	4.00	4.69	5.29
Female	1.21	1.27	1.37	1.50	1.65	1.83	2.07	2.29	2.41
Total	3.41	3.60	3.87	4.24	4.78	5.31	6.07	6.98	7.70

Source: See text.

Classification by occupation and type of income-earner

The next stage involved the classification of this total by occupation or sector of activity. The margins of error involved are quite large as soon as we move away from the relative security of the 1851 and 1841 censuses, but it must be remembered that the object of the present paper is to compile an index of wages. In this context the classification is needed for the weighting of the series for separate occupations, and it would require the combination of quite large errors in the allocation, together with substantial differences in the level of average earnings across the sectors, to make an appreciable difference to the final index.

The classification for 1851-81 relies essentially on the census returns as summarized by Booth, with adjustments for the retired and for the omitted armed forces and merchant seamen; and that for 1841 on the corresponding amended estimates made above in arriving at the totals for males and females. For earlier years separate estimates of the number of occupied males and females were made for as many individual sectors as possible, and the remaining sectors were then allocated a rough share of the residual.

For agriculture, the construction of a series started with Wrigley's estimates for 1811-51 of the number of males in England aged 20 and over employed in farming (1986, p. 332). This was raised to cover Wales and Scotland, and additions were made for males aged less than 20, for female labourers, and for male and female farmers. A very rough extrapolation to 1761 was then made for male labourers and farmers in Great Britain, paying regard to the estimated size of the rural agricultural population in 1750 and 1801 (Wrigley, 1987, p.170), and of the total civilian male labour force. The series was completed by the addition of estimates for female labourers and farmers. For the former the ratio to male labourers is believed to have declined since the mid eighteenth century, and it was taken as 18 per cent in 1761, compared to 12 per cent in 1841.

For other sectors, the indicators used were the number of coal miners given in Mitchell (1984, 106) for 1801-51; the number of merchant seamen on vessels registered in the United Kingdom available annually from 1788 (*Finance Accounts, Trade and Navigation*, annual), extrapolated to 1761 on the basis of the series for seamen's sixpences (Davis, 1956, 339-40); the number of male domestic servants for whom assessed taxes were paid for 1811-41 (Porter, 1847, p. 539); and the numbers in the army and navy (Floud et al, 1990, 45-71).

The remaining male and female occupations, including building and manufacturing, road and canal transport, distribution, and female domestic servants were then allocated roughly the same share of the residual labour force as in 1841 and 1851, with a few rough adjustments and changes where this seemed appropriate.

The male and female labour force in each sector was then further sub-divided to distinguish three categories of income-earners: employers and the self-employed, salaried workers, and wage-earners. This classification starts from a detailed analysis of the census returns for 1861, made for an earlier study (Feinstein, 1989, 245), which classified approximately 12 per cent of the occupied population as employers and self-employed, 6 per cent as salaried workers, and 82 per cent as wage-earners.[40] There are also some figures on the number of employers and self-employed in 1851, in addition to the census classification by occupation.[41] The distinction between salaries and wages is not very sharply defined: clerks, nurses and teachers are treated as salaried, shop assistants and policemen as wage-earners.

The proportion of employers and self-employed, and of salaried employees was estimated separately for males and females for each sector, leaving the number of wage-earners as the residual. The decennial totals for 1771-1851 are shown in the lower panel of Table A1.

Finally, wage-earners in manufacturing were sub-divided between six industries: metal manufacture and metal-working, cotton, wool and worsted, other textiles, dress, and other manufacturing. This was done partly on

[40] The estimates published previously were for the United Kingdom but those given here relate to Great Britain only.

[41] See the incomplete returns included in the 1851 Census, *Summary Tables*, PP 1852-53 LXXXVIII, Part II, p. lxxvii.

the basis of the classification in the 1851 census, partly on evidence for developments in particular industries, notably cotton and wool; and partly on rough adjustments to reflect the known trends.[42]

APPENDIX C

A new index of the price of clothing and footwear

The series used to measure the prices of clothing and footwear in the previous cost of living index (Feinstein, 1995) has been replaced by a new series which is still provisional but is, I believe, a marked improvement on the earlier version. The present series consists of spliced indices for short overlapping sub-periods, in each of which three series for clothing are combined with one for footwear. The sub-periods are selected in order to allow for the growing importance of cotton relative to the other types of cloth. Its percentage share increases from 15 for 1770-1802 to 25 for 1800-1823, 32 for 1820-1845 and 40 for 1840-70. The corresponding percentage weights for wool are 50, 40, 35 and 33; and for linen: 20, 20, 18 and 12. Footwear has a constant weight of 15 per cent.

The allocation for footwear was based on early twentieth-century data (Prest 1954, 123), but is roughly consistent with information in late eighteenth-century household budgets (Davies, 1795; Eden, 1797, III, cccxliii). The division of clothing by type of material was made on the basis of estimates of the value of home consumption (output less exports) of each of the three types of cloth (Ellison, 1886, 56-60, 117-26; Deane and Cole, 1962, 185-7, 196 and 204; von Tunzelmann, 1978, 231) The value of home consumption was first estimated for each decade and the periods listed above were then selected to reflect the broad timing of the shift away from the traditional materials towards cotton. The initial estimates for home consumption of cotton were adjusted upwards (by an arbitrary five percentage points), with a corresponding reduction in the share of wool and linen, on the assumption that in this period the proportion used for other purposes (e.g. sails, industrial materials, and household furnishings such as carpets, curtains, blankets, and sheets) was greater for the other fabrics than for cotton.

Woollen clothing

The index for woollen clothing is an unweighted average of series for different periods as follows:

1770-1829: blue cloth purchased by Greenwich Hospital (Beveridge, 1939, 293-5)
1770-1822. average export value of woollen cloth (Cuencas Esteban, 1994, 101-2)
1792-1833: price charged for red cloth supplied to the Army (PP 1833 VII, J. Pearse, Q. 530),
1792-1833: the cost of a suit of clothing for a soldier of an Infantry Regiment (PP 1833 VII, R.H.Cox, Q. 1437),
1818-68: Suits purchased by Greenwich Hospital (PP 1837 V, PP 1850 XXXV, PP 1854 XLII, McCullough, 1882, 1139-40)
1818-70: average export value of woollen manufactures (Imlah, 1958, 211-3)

The critical difference between these indices is in the extent of the decline in the price of woollen cloth after the end of the Napoleonic wars. Imlah's index of export average values is 45 per cent lower in 1829 than in 1816, whereas the reduction in the various series for domestic institutional purchases is only about 25 per cent. From 1829 to mid-century the export series falls by a further 30 per cent, whereas the domestic series show a rising trend. The combination of these series used in the present index is 34 per cent lower in 1850 than in 1816, and this probably overstates the decline.[43]

I have previously suggested that a substantial part of the steep decline in the export series might be the result of changes in the composition of woollen exports rather than a reduction in the price of cloth of a given quality.[44] It is not possible to verify this directly because the trade data cannot be sufficiently disaggregated, but the proposition appears to be confirmed by information on the prices of woollen trousers, for which it seems reasonable to assume that there was little or no change in the nature of the basic article.

From 1760-90 breeches were supplied to the Navy at prices ranging from 3/6 to 4/6; the price for trousers would typically be about 25 per cent higher, say 5/-. Figures quoted for trousers purchased for privates in the army include 6/6 for 1792 and 1798, increasing to 9/6 for 1815 and then falling to 7/- to 8/- in the early 1830s.[45]

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[42] For cotton, Wood (1910) pp. 593-9. For wool the estimates for 1851 were based on Baines (1970) p. 91 and for 1831 on McCulloch (1839) I, p. 627; the latter estimate was extrapolated back to 1771 on the basis of the consumption of wool.

[43] In their revised index for clothing Williamson and Lindert (1985) p. 149 adopted the export series as the sole measure of changes in the price of traditional textiles, and so show a much larger fall.

[44] Feinstein (1995) p. 17. I also suggested in that discussion that the price fall for finished garments might have been moderated because the steep decline in the cost of cloth was not matched by a corresponding reduction in labour costs, but further investigation has shown that labour costs were a relatively small proportion of the total (about 15 per cent for a basic coat and trousers); see, for example, PP 1833, VII Qs732 and 1235.

[45] Warrant of 14 January 1792 showing list of necessaries to be provided free for every foot soldier, PRO, WO 30 13B f. 32-4; clothing for Royal Military artificers and labourers, SP 1798, vol 113, App. E.3, p. 438; PP 1833 VII, Qs. 541, 732 and App. 4, p. 303-5.

By 1850 the price had risen again to 9/4 for the cloth only.[46] For 1859-60 a comparison of contract prices with those charged by the newly-established Army clothing factory showed that for trousers the former price was 10/- and the latter 9/9, but by this time there had been a considerable improvement in the quality of the material used and the equivalent price for the former quality would be roughly 70 per cent of this, about 7/-.[47] This data on trousers purchased for the armed forces thus gives no indication of a fall in price as steep as that shown by the average export values.

Prices for trousers for agricultural labourers show a similar pattern. At the end of the eighteenth century the price appears to have been about 4/- or 5/-.[48] For later dates, Purdy (1861, 369-70; 1862, 475-6) quotes prices of 9/- for an agricultural labourer in Devonshire in 1837, of 6/6 and 7/6 for indoor paupers in London and Bedford in 1860, and of 8/- to 10/- for agricultural labourers in Scotland in 1860. Rough confirmation of this level of prices in mid-century is given by evidence by a Royal Engineers Quartermaster to a Commission on Army recruitment that from enquiries in 1866 'at some of the clothing establishments most patronised' by the labouring class he had established that the prices at which 'the labourer can procure his working clothes when new' included 8/6 for strong well-sewed moleskin trousers (PP 1867 XV, App. J, p. 248).

Other clothing and footwear

The movement in the price of cotton cloth between 1770 and 1815 has been a matter of sharp controversy (Cuencas Esteban, 1994, 1995; Crafts and Harley, 1995), but fortunately the weight of cotton clothing in the overall index of retail prices is too small for this to be of major importance in the present context. The controversy has generated an number of new series, of which the following appear to be the most reliable:

1770-1813: calico piece goods sold in England by the East India company (Cuencas Esteban, 1994, 72-3)

1768-9, 1777 and 1781-1798: two series of Birley, Cardwell and Hornby inventory prices for fine and superfine cloth (Crafts and Harley, 1995, 136-7).

From 1812 to 1870 an unweighted average of these series is spliced to Neild's series for grey cloth as adjusted and extended by Sandberg (1968, 8-10).

For linen the index is based on the price per yard of linen goods stamped in Scotland from 1770 to 1822 (Warden, 1864, 480), spliced from 1818 onwards to the average export value of linen piece goods.

Finally, the series for shoes is based on prices for purchases by the following institutions:

1770-1798: the Navy (PRO, ADM 49/35).

1770-1829 the Lord Chamberlain's Department (Beveridge, 1939, 293-5, 457).

1770-1853: Greenwich Hospital (Beveridge, 1939, 293-5; McCullough, 1882, 1139-40).

From 1846 to 1870 the index is continued by means of the wholesale price of leather (Sauerbeck, 1886, App. B).

This revised index of clothing prices rises by only 12 per cent between 1795 and 1814-16, compared to an increase of 38 per cent shown by the Lindert and Williamson index (1985, 148). The more moderate upswing reflects the abandonment of the index compiled by Tucker (1936) which was used by Lindert and Williamson (and also in my previous series).[49] The new clothing index also falls much less sharply from the war-time peak to mid-century (by 46 per cent rather than 64 per cent), mainly because of the new series discussed above for woollen and worsted clothing.

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[46] Clothing contracts Letter Book, PRO, WO 4/512.

[47] PP 1861 XXXVI, p. 281. The abolition in 1855 of the old system for the purchase of clothing resulted in a great improvement, so that 'material now worn by the privates was equal to what was formerly supplied to non-commissioned offices' (PP 1867 XV, p297); in the first half of the century trousers bought for army privates generally cost about 70 per cent of those for sergeants. The cost of 'trowsers' provided for policeman in the Metropolis was as much as 12/3 in 1850, though this was presumably a higher quality garment (Fletcher, 1850, 228).

[48] This is based on Eden (1796, I, 557; III, cccxliii) and Davies (1795, 137-85); prices for trousers are taken as roughly 25 % more than those for knee-length breeches.

[49] The precise composition of his series was not reported by Tucker, but reference to his sources shows that the steep rise in his index is largely the result of an exceptional increase in the price paid by Greenwich Hospital for a single small item: stockings.

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